ACP
AMERICAN COLLEGE OF PROSTHODONTISTS®

Let's Talk about Statistics and Prosthodontics Research: Part 1

Nellie Kremenak, PhD[1] & Amy L. Weaver, MS[2]
[1] Manuscript Editor
[2] Division of Biostatistics, Mayo Clinic

To help with this discussion (and to help the Manuscript Editor keep from getting in over her head), Amy Weaver, the *Journal of Prosthodontics* statistical consultant, will coauthor these remarks.

In this issue, we will talk about the statistical analysis of data and what it is. In a later Tips, we will discuss related issues, including sample selection and bias, and we will provide some pointers on how to select an appropriate statistical test.

First, let's note the distinction between plain, ordinary statistics (e.g., population statistics), which involve counting everything (or everyone), and inferential statistical analysis, which tests the likelihood or probability that particular findings occurring in a random sample of individual units drawn from the population of interest could have occurred accidentally or by chance.

Inferential statistical analysis addresses a specific research question or hypothesis. The question is formulated by specifying a null and an alternative hypothesis. The null hypothesis might be that there is no real difference between the means for some measure of materials A and B. The alternative hypothesis would be that there is a genuine difference between the means. Statistical analysis, when properly applied, helps the researcher and his or her readers answer the question "What is the probability (likelihood) that these results could have occurred by chance rather than as a result of the variables involved (e.g., different materials or combinations of materials or varying temperatures or time intervals)?" Stated another way, "What is the probability of obtaining a result as extreme or more extreme than observed in this sample if the null hypothesis is true?" This probability is referred to as the *p*-value. In the health sciences, a *p*-value of 0.05 or lower is generally regarded as a respectable degree of certainty for research findings.

But how does the researcher arrive at that evaluation? The process involves both the plan or design for the research and mathematical calculations to evaluate the findings in terms of the original hypothesis. Doing the math to evaluate the results can be facilitated by software such as SAS© (SAS Institute Inc., Cary, NC) or SPSS© (SPSS Inc., Chicago, IL), but the best option is to consult an expert right at the start. A wise professor once told a novice researcher, "Researchers need to work with a statistician to keep from making fools of themselves." Researchers are usually experts in their fields—for example, prosthodontic treatment or materials—but less so in statistical design and probability testing. For this reason, including a statistics expert as part of your research team is a sound idea. This individual can advise on study design and adequate sample size, as well as on selecting the appropriate statistical tests for evaluating results. Often, the statistical consultant is listed as an author on the research report, or if the consultant's contributions are not enough to warrant listing as an author, he or she should always be thanked in the "Acknowledgements" section.

Next time we will discuss bias and sample selection and how to choose a statistical test that is appropriate for the conditions of a particular research project. We will look at these issues with a particular emphasis on materials research and the problems raised by the lack of independence that occurs when comparing such outcomes as differing procedures performed on teeth from the same subject or animals from the same litter.